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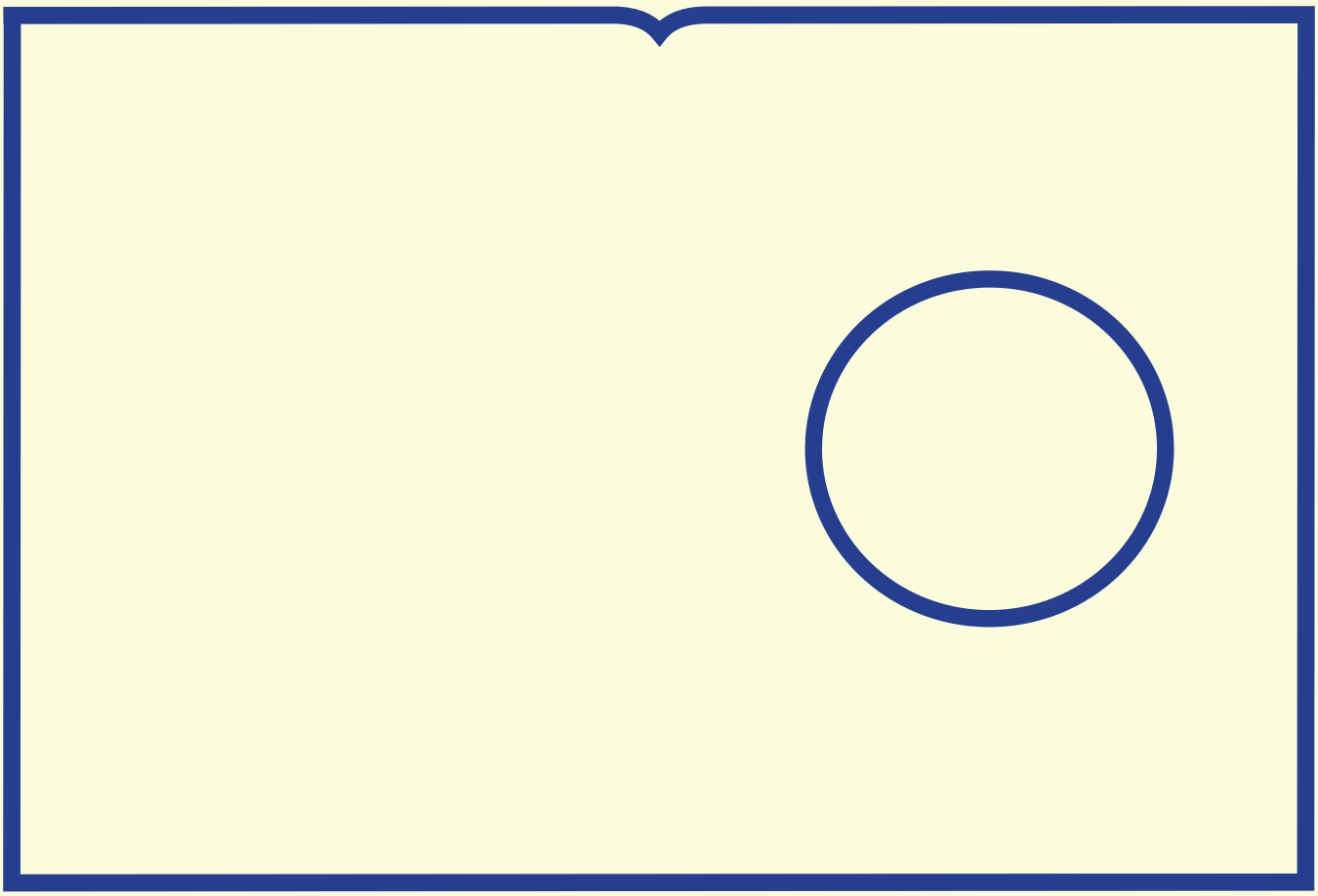

The Act of Drawing in Early Childhood Education

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CEPAOS

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In this paper we utilize some findings of Neuroscience to reflect on drawing as an important curricular component in Early Childhood Education. We understand drawing as a capacity that emerges in the evolution of the human species, we discuss the child´s genetic predisposition for the activity of tracing the basic elements of drawing (point, line, angles and circle) and how the activity of tracing evolves in young children with the beginnings of visual narrative in the period of Early Childhood Education. Finally we consider the educational interventions that contribute to the full development of visual narrative in young children. We point out the importance of including approaches based on Neuroscience in teachers' education programs so that they can guarantee the proper context and time for children continuously exercise the act of drawing to develop his/her imagination and create new memories.

Based on Neuroscience and its necessary intersection with Anthropology, on one hand, and considering the Arts and Aesthetic experience on the other, Souza Lima developed a curriculum for Early Childhood Education appropriate for the developmental processes of young children: Viver a Infância (LIMA, 2005). In it, drawing is established as daily practice, given its potential as expressive system. It contributes to the process of building the child's identity, in addition to its role in the acquisition of writing and its usefulness in the acquisition of school knowledge in various areas. The project contemplates a continuing education curriculum for teachers that includes the contributions of Neuroscience as well as the understanding of the anthropological and semiotic dimensions of drawing production. The drawings presented in this article are by children from the Escola de Educação Infantil (Pre-school) of the city of Guarani in the state of Minas Gerais, Brazil, under a team of teachers coordinated by Heliana Bellotti (3). And by children from a low income neighborhood school in the periphery of São Paulo, taught by teacher Fabiana Alfim. These are clear examples of the potential of young children to carry out complex visual narratives when teachers are familiar with the perspectives of brain science on drawing as a fundamental tool of human development.

INTRODUCTION

Every human being is able to trace, an activity that begins in infancy, given that we have a genetic basis that regulates it. Tracing activity evolves in time into drawing associated with narrative in the process of cultural development. Drawings are made possible by the concatenation of movements of the arms, hands and fingers and by the circularity of the wrist, under the guidance of the motor cortex, articulated with memories: memories of movements, memories formed from perceptions of the external world (visual, auditory, tactile, olfactory) and those of internal, proprioceptive perceptions.

In a general sense, we can say that drawing emerges in the human developmental process from the graphic activity related to neuromotor and perceptual developments of the species at the origin, among other modalities, of the various graphic forms of communication which "culminate" in writing.
Thus, drawing – the graphic act, its means and its results – is an element of intellectual and emotional life, it is both origin and result of the development of perception, manual skills, symbolization, and of the interrelated capacities of cognition and expression in the vital relational processes characteristic of human societies.

This characterization is of great importance also for the understanding of drawing as an artistic discipline in our time, as the cultural context marked nowadays by technological development transforms the disciplines and their boundaries. Technology transforms the means of knowledge, communication and expression, and it relates and transforms in depth the "means of production" considered in general terms and consequently transforms our material and symbolic forms of life.

Point, line, plane and figure, which are the primary generative elements of spatial analysis and representation, emerge in drawing as "concrete abstractions" characterizing the essential processes of mediation proper to drawing, its processes of spatial-temporal identification and projection, the mapping of relationships and helping to construct the experience of self and of the world. (LIMA, M. G. 2018)

DRAWING IN THE EVOLUTION OF THE HUMAN SPECIES

Drawing is a capacity that emerged in the evolution of human beings at least 40,000 years ago with the appearance of proto-language witnessed or exemplified in attempts to represent an action with pictorial elements using basically traced forms. Later on, after an interval of approximately 35,000 years, indicating a long process of adaptation and cerebral organization, writing was invented in several cultures, the oldest ones around 5,000 years ago.

Between these two milestones of development, we have the cave paintings, exceptional in the domain of representation and forms, dated from 25,000 to 30,000 years ago. In this process human beings created and developed symbolic capacities, created graphic symbols and the first symbolic systems such as writing and mathematics. Proto-language records found in Africa, as we mentioned, were dated 40,000 years ago. Hunting instruments and artifacts with decorative, parallel or zigzag features, found in regions of Europe, belong, according to specialists, to the same period. Musical instruments such as flutes dated 20,000 years old have traced elements that may be considered as ornaments.

The ability to draw symbols is a milestone in the evolution of human beings. Drawings and paintings in caves show great development as forms of visual narratives. There was probably a continuous development of drawing on supports that did not resist the passing of time. However, on the rocky walls of the caves and shelters the permanence of the image drawn or painted with the use of pigments and binders was achieved as a result of chemical interaction between materials found in nature with human body fluids such as saliva and blood. Mithen (1996) considers this moment as a transition to complex levels of manual mastery and aesthetically sophisticated visual design, a true creative revolution, a milestone in the evolution of the species. Pfeiffer (1982) had already referred to the period as the creative explosion, which changed the course of prehistory, marking the beginnings of a symbolic evolution of the visual arts in caves, followed by the beginnings of mathematical markings, which are at the origin of the invention of writing 20,000 years later.

Two aspects are important to us here. First, we can say that drawings are in an important sense "messages for the future". They are records that remain beyond their period of creation, they stay for posterity, either immediate or distant, thus modifying the temporality of human life by creating and stabilizing memories that can be apprehended by the senses (vision) and recreated in the emotional and cognitive experience of contemporary people or by people living tens of thousands of years after the drawings were produced.

A second relevant aspect is the actual observation of the exercising of memory: to draw inside the caves the authors created memories of the perceived images (animals, geographical landmarks such as plains and rivers, celestial phenomena) in the space outside the caves and recreated them inside the caves by retention of the images in their brains. Thenceforth, drawing establishes itself as an integrated cultural product of the species.

Drawing is an act of symbolic creation, of giving meaning to drawn marks, lines and figures, it is a symbolic construct accomplished by the integration of the intention guiding the making of the line and what the line (4) reveals once recorded in some type of support. Recording, in this case by means of graphic elements and procedures, as a selective process is already a creative act that, starting from perceptual activity and its components, helps to structure and signify perceptual experience.

DRAWING IN EARLY CHILDHOOD

The child's drawing is a cultural product integrated with a biological basis which discloses the functioning of the brain and informs us about how the child perceives the world in which he/ she lives. It says a lot, too, about the child´s personal collection of memories, symbolic capabilities and the state of his/her geometric thinking.

Drawing, as we pointed out, begins with tracing. The evolution of the act of drawing is clearly evident in the developmental process of the child. Tracing evolves from the movement of free lines to curved lines that come together in rounded shapes, to straight lines that come together at right angles (90º) and also at smaller or larger angles, making it possible for the child to draw geometric figures: circle, oval, quadrilaterals (squares, rectangles and trapezoids) and triangles. This process is granted by the genetic constitution of the species and happens in line with the maturation of the brain; thus, age is an important reference for understanding the evolution of children's drawings.
From the lines of the first years of life, it emerges from the age of 2-3 years old onward the progressive appropriation of geometric figures, starting from circles and ovals initially to triangles achieved around the period of 5-6 years old. The combination of these elements is at the basis of the evolution of drawing. Before Psychology and Neuroscience, Anthropology was able to disclose this natural evolution (MEAD and WOLFENSTEIN, 1970).

When the movement made with the finger or by means of an instrument such as a pencil is recorded on a support, the child re-appropriates as an image in the brain that which was initially his/her own physical movement. Performing similar movements several times, seeing the result on paper (or other support) creates a mental model of the movement, as a kind of "map" to produce again the movement. This is the very procedure for learning to write: to form mental maps of each letter, syllable and word.

Every child can draw. Although drawing occurs independently from the schooling process, the experience at school influences in different ways the progression of drawing, either positively or negatively: depending on how the activity is structured in school practice, the child may have little interest in drawing, may create drawings with impoverished formal solutions and stereotyped forms or may even refuse to draw. Those are problems that need to be solved given the importance of drawing in human development, as we observed. It is fundamental that the activity of drawing be included in the curriculum as an activity that is essential for the full development of the symbolic function. Drawing must be part of the curriculum starting at day care and preschool in order to develop visual narrative practices enriched by sensory experiences, by explorations of nature, by experiences of movements of the body in space, and by literature and poetry.

NEUROSCIENCE AND DRAWING

The research and knowledge accumulated by brain science in the last decades can contribute to education by stressing the relevance of the various contents and their essential relationships in the school curriculum, considering that it is proper to the brain to link and by that to "cross-fertilize" the disciplines within the learning process. Thus, elements and processes developed in drawing practice provide the basis for learning in mathematics, geometry, writing, among others. Brain science revealed that the constant action of drawing transforms the functioning of the brain. Such finding supports the inclusion of drawing in all levels of education, but it is mainly in Early Childhood Education and Elementary Education that the presence of drawing as curricular content is essential to brain functioning, both because of the symbolic resources it offers during brain maturation as well as the necessary contributions to the development of other domains of thought.

Here are some implications of neuroscience research about the act of drawing. (5) The act of drawing forms narrative structures in the brain. The child's drawing activity develops as narrative supported by internal speech.

In this way, speech areas in the brain are activated when the child draws.

Drawing educates attention, helping to form structures of focus and concentration and contributes to form and develop executive attention. In reality, drawing promotes attention and concentration of a different nature from that which the child develops, for instance, when using technological instruments (TV, cell phone, computer). Thus, it is a very effective strategy to propose drawing activities to form attention, focus and concentration behaviors necessary for school learning. It is important to note that attention behaviors established while drawing will be extended to other forms of activity.

Drawing develops the executive functions of planning, anticipating results and making decisions, located in the frontal area of the brain. Drawing allows the formation of neural networks in the motor cortex, in the regions of controlled movements in the hands, grasping, control and identification of the fingers individually. Drawing leads to the integration of neural networks of areas of vision, touch and movement.

Drawing has great impact on memories:

- It exercises working memory.
- It evokes long-lasting memories. That is, it dynamically activates the collection of images stored in the brain.
- It forms new memories.
- It favors concepts formation in long-term memory.
- It consolidates events and elements of autobiographical memory.
- It collaborates to learn and memorize the "motor form" or "motor map" of the letters. That is, the movements to "draw" the letters, which is a constitutive factor of writing.

Drawing can be part of learning activities and can also be a study activity in itself: observing, perceiving and recording with the help of drawing intensify the synapses between neurons that occur in the various learning processes, and help to stabilize memories.

Drawing brings some important contributions to the child's brain development:

- It trains the brain to pay attention and maintain attention behavior for a long time.
- It stimulates individual cells and groups of cells in the visual cortex for line and shapes.
- It promotes the practice and organization of patterns in thought.
- It exercises imagination and forms behaviors associated with creativity.

Drawing releases neurotransmitters that cause feelings of well-being and decrease anxiety.

Drawing mobilizes the emotional system and activates the expressive systems in the brain.

The act of drawing, as we have seen, had an impact on the evolution of the species, notably on memory and on the creation of symbols and symbolic systems. Thus, considering the facts presented above, we conclude that constantly promoting the activity of drawing impacts the development of children expanding their internal resources.

TRACING NARRATIVES – CHILDREN´S DRAWINGS (6)

In the program Viver a Infância (LIMA, 2005), drawing is considered as one of the pillars of child development and thus it is promoted as a daily activity for children aged 3 to 6 years. In the anthropological perspective of child development (MONTESSORI 1912; MEAD 1970; LIMA 2013, 2016) drawing is characterized as a cultural activity independent of schooling. That is, every child draws whether or not they go to school. Children who do not know paper, books, pencils also draw in other supports and present the same sequence of point and line to

elaborate combinations of lines and flat geometric figures.

There is a rich documentation in the anthropological literature of graphic productions of unschooled children in all cultures (MEAD, 1970; LIMA, 2019). In Figure A, we can observe this fact. This is a drawing made by an uneducated and illiterate child from the Tikuna people (Amazon region, Brazil), an indigenous group of great sophistication in their pictorial production with elaborated aesthetic sense (LIMA, 1998). It is an indigenous society and culture in which everyone draws with great concentration, at any age. The symbolic context is dense and offers children situations that are extremely conducive to expression, creativity and the use of imagination. This nine-year-old child presents in his drawing a narrative of the natural and cultural life of the community. When we carefully observe the tracing shapes presented in the drawing, we can clearly see the use of point, curved and straight lines, different sinuosities, angles, geometric figures articulated with each other for the formation of the elements of the narrative.

Figure A - Desenho Tikuna | Source: Desenho de criança (9 anos). Pesquisa Função Simbólica e Cultura na Infância, 1994.

This drawing shows us very clearly that, in the human species, tracing is part of the biology of the species, and the cultural experience, integrated with the biological determinants, leads to the elaboration of narratives associating forms, images and meanings in creative compositions of great originality.

Even though he was not taught to write, the child "copies" what the coordinator (Elvira Souza Lima) had written on the blackboard. That is, he is able to reproduce the graphic part of the writing very well, although he does not understand the meaning of what he is copying, because, for this, he needs to be taught the syntax and semantics of the Portuguese language. However, the graphics of the words are perfect, demonstrating the intrinsic link between the practice of drawing and the ability to reproduce the graphic elements of writing. In a careful analysis, we can see that all the movements necessary to master alphabetical writing are present here. To draw the letters cursively, uppercase and lowercase, the child already has the memory of the necessary movements. It is important to emphasize that writing is a consequence of drawing and that drawing itself is a complex form of knowledge practice that contributes to generating concepts and forming collections of memory.

Figures B and C reveal the symbolic nature and the structure of drawing as narrative. These drawings are of two 5-year-old children, from the same class at the Escola de Educação Infantil (Pre-School) of the city of Guarani in the state of Minas Gerais, Brazil. In this school Elvira Souza Lima had the opportunity to collaborate with the team of educators in the implementation of the educational program Viver a Infância, with the elaboration of a curriculum structured around music, drawing, narrative, literature, dramatization, mathematical thinking and scientific thinking. (LIMA, 2005). As for drawing, the proposal from the Viver a Infância framework is to draw every day, alternately on A3 and A4 size sheets and with a specific curriculum (LIMA, 2005).

Figure B - Cena Boto | Source: Children's drawings (5 years). Project Viver a Infância, Escola Infantil de Guarani, MG, 2007

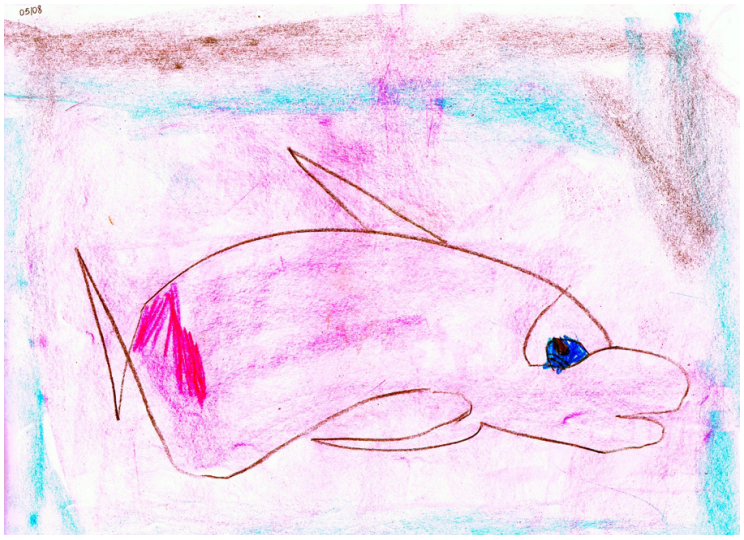

Figure C – Boto | Source: Children's drawings (5 years). Project Viver a Infância, Escola Infantil de Guarani, MG, 2007

Focusing on the subject that concerns the present text, which is drawing as a cultural product of the child, I highlight two drawings made from the reading of a story about a dolphin done by the teacher (Figures D and E). In these drawings, we have a very clear example of the diversity that children's imagination can present. They are two examples of visual narratives of rich and attractive aesthetic elaboration, however, using completely different elements. In the drawing of Figure B there is a profusion of details for the construction of the narrative, while the child author of Figure C presents a narrative with few elements and economy of details. The drawing of the dolphin in figure C (representing a Boto: the Amazonian region river dolphin species, a central character in native mythological narratives and folk tales) produces an impact by the expressive representation produced by a decisive tracing. In Figure B, in turn, the movement of dolphins draws attention by the dynamics of graphic forms, representing the very dynamic content of the narrative. These drawings are compositions marked by the particular sensitivities and different choices made by each child.

The following images (Figures D to G) are of children in contexts of human development structured according to the educational project Viver a Infância, taught by educator Fabiana Alfim, who was part of one of my study groups of Neuroscience in a 5 years program. Since the beginning of the program, she showed enormous interest in applying her newly acquired knowledge about brain functioning to think, plan and implement a curriculum for her classroom.

Figure D - Estrela das Águas 1

Figure E - Estrela das Águas 2

Figure F - Tisiu mamãe macaca

Figure G - Tisiu peixes na água

Fabiana Alfim organized the activity of having the children (4 to 5 years old) illustrate a story read (7) to them. Reflecting on the experience, she stated: "An experience that deserves to be highlighted among those I was able to organize was the illustration of the book Histórias da Natureza (Stories of Nature), the narrative of an indigenous legend, a tale about water and a story with animals as characters. Children were asked to represent through drawing, their interpretations after listening to the teacher's reading. It was an intense exercise of imagination and creativity. We had incredible works, which exceeded what is usually expected for the specific age group (Figures D to G). There were drawings that in their wealth of details revealed all the concepts previously studied. When drawing a starry sky (Figures D and E), children discussed concepts of astronomy. When drawing animals, they selected characteristics of the development of mammals, birds, reptiles, fish, amphibians, viruses and bacteria. (Figures F and G) When exploring colors and shapes, they remembered the elements of works of art of artists they we had explored before. These were surprising results that encouraged me to continue in this path. Now, as School Director, during teacher training meetings, I continue to expand the teachers' knowledge about the articulations of brain science in the classroom. All training must consider elements of human brain function and human development to organize and evaluate pedagogical actions that will lead to effective learning. (ALFIM, F. written testimony 2019)

Final considerations

The drawings reproduced here show how to expand the visual narrative of young children related to the continuing education of teachers that includes brain science findings as an important component to understand child development. Every child is capable of tracing the basic elements of the drawing: line, point, straight lines and curves, circles and ellipses, quadrilaterals and triangles, the flat geometric figures. This is possible by factors and elements that are part of the genetic constitution of our species. Combining these elements for the production of narrative depends on exercise. The composition of visual narratives depends on concrete and frequent situations focused on drawing. We see that the child expands his/her imagery repertoire through the constant practice of drawing, incorporating new information and new perceptual elements on a given subject when it is approached in the school curriculum in the same way as, for example, the study of mammals (Figure G) or the story of the traditional legend of the Vitoria Régia flower (called the Star of the Waters) (Figures D and E).

We also can see that decisions are made very early on by children. The choices presented in creating the dolphin from the same stimulus (the story read by the teacher) can lead to distinctly different results (Figures B and C), and yet equally rich in meanings, with dedicated aesthetic elaboration and complexity in the making of the drawing. These two drawings show the pictorial capacity of young children when the teaching context created by the teacher is based on adequate biological and cultural knowledge about child development. Thus, we can apply to the development of children the same notion of the role of drawing we identified in the development of the human species as promoting the formation and expansion of memories and as predecessor of the invention of writing.

By including drawing in Early Childhood Education curriculum we promote adequate conditions for human development. In this way the exercise of the symbolic function, that is so necessary in this period, is supported and the formation of neural networks that will be recruited for various subjects and types of learning is also supported, and this not only in respect to curriculum content, but to methods.

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NOTES

(1) Elvira Souza Lima – studied Psychology at the Catholic University, PUC, São Paulo. She studied Music at the Conservatório de Música de São Paulo, Brazil. She has a master's degree in Psychologie de l´Éducation (Psychology of Education) and a doctorate in Sciences de L´Éducation (Educational Sciences) both degrees at Sorbonne, Paris V University, France, and completed a Post-doctorate in Anthropology and Linguistics at Stanford University, USA. She studied Neurobiologie de l´Enfant (Child Neurobiology), with Julian de Ajuriaguerra at the Collège de France, Paris, and was a postdoctoral fellow at Rutgers University, USA. She worked as researcher in Brazil, France and the United States, and as university professor in Brazil (University of São Paulo), United States (Hofstra University), and Spain (University of Salamanca). She has consulted for several Municipal Education Networks in the states of São Paulo, Rio de Janeiro, Minas Gerais, Santa Catarina, Paraná and Rio Grande do Sul, in Brazil. The present paper is based on E.S. Lima, M.G. Lima - Neurociência na educação infantil: o significado do ato de desenhar - Paidéia: Univ. Fumec, Belo Horizonte, Ano 13 n. 20 p. 149-165 jul./dez. 2018

(2) Marcelo Guimarães Lima is an artist, researcher and professor. He has a PhD degree in Art History, a Master of Fine Arts degree in Printmaking and Painting, both degrees from the University of New Mexico (USA) , and a Post-doctoral degree in Philosophy from the University of São Paulo. He was a visiting artist and visiting scholar at Stanford University (USA), Rutgers University (USA), Nothwestern University (Evanston IL, USA), and at Universidad Internacional de Andalucia (Spain). He taught at the University of Illinois (USA), Goddard College (USA) and at the American University in Dubai (United Arab Emirates).

(3) Monica Ornellas Dias Correia, Angela Maria Dutra Vieira, Darcileia Aparecida, Xavier Vieira, Juliana de Souza Costa Oliveira, Francisca de Souza Lao, Amanda Fagundes Costa, Célia Regina de Macedo.

(4) Trace is the record (mark) on a surface of movement performed by a human subject, usually movements of arms and hand, although it is also possible to create traces with movements of the legs, feet and toes, with the mouth and even with the whole body. There are countless examples of people who, without an arm or with limited movement of their arms and / or hands, develop great skills to trace and compose pictorial narratives.

(5) Here we bring together knowledge made available by Neuroscience with research designed and carried out by Elvira Souza Lima.

(6) The analysis presented below is focused on the work done by Elvira Souza Lima.
(7) Histórias da Natureza (Stories of Nature), is one of the components of the series Ler se Aprende com Cultura (Learning to read by cultural approach), composed of 5 DVDs and 5 books. Histórias da Natureza brings together 3 stories by Iza Ramos de Azevedo Souza addressing basic human values. The book is designed with pages for the child to illustrate the stories after listening to or reading the narratives.

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